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GAS ABSTRACTS

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1. GAS INDUSTRY

Carthage Gas Field

Foster, F. K. CARTHAGE GAS FIELD DEVELOPMENT. *Oil Weekly* **124**, 33-44 (1946) *December* 23.

The Carthage gas field, located in Panola County, Texas, 45 miles southwest of Shreveport, was discovered in the latter part of 1936. Development did not get under way to any great extent until 1944, after the completion of Feazel and Kinsey Jordan 1 (Chicago Corporation Carthage Gas Unit No. 1). The productive area now covers between 250,000 and 300,000 acres, far surpassing other U.S. gas condensate reserves. The structure is a broad domal anticline with little or no faulting. Gas and condensate are produced primarily from the Pettit zones of Lower Cretaceous Age between 5800 and 6200 feet in depth. To date, 238 wells have been drilled, of which 222 were completed for gas condensate production, 16 were dry holes, and 20 are drilling. The current September 1, 1946, daily average allowable from the field is approximately 1000 Mcf per well. Condensate production averages for the field approximately 14 barrels per million cubic feet of gas.

Author's abstract

Gas Conservation

Carter, D. V. GAS CONSERVATION IN WEST TEXAS. *Oil Gas J.* **45**, 74-77, 86 (1947) *January* 11.

The author points out that West Texas sour gas need not be used for the manufacture of carbon black any longer since means of removing H_2S are available. A price of 4 to 6 cents per Mcf may now be obtained. Gas conservation and increased operating efficiency are stated to be required for sound operation.

J. D. Parent

Gas Industry

Dotterweich, F. H. THE INTRINSIC VALUE OF NATURAL GAS—A NATIONAL ASSET. *Am. Gas J.* **165**, 11-14, 58 (1946) *December.*

A greatly expandable natural gas industry supported by adequate reserves rendered great service during the war period at which time its increasing value was recognized and an adequate program for conservation was pursued under state control in the principal producing states. Solution of technologic problems alone was not the answer to its conservation, but as has been shown, an increase in the value of gas brought about by the establishment of new markets for dry natural gas. Rigorous and valuable research conducted by the natural gas and related industries has not only expanded their own frontiers and brought greater value to their products, but also brought advantages to competitors who until lately have not been research minded. So that natural gas and its derivatives may better serve in times of peace and be ready to help defend in times of war, its use must be allowed to expand in the truly American environment of competitive bargaining; research must continue; its conservation must remain a State right with a minimum of Federal control so that the great reserves of natural gas may be used to improve the American way of life throughout the country.

Author's conclusion

Gas Industry

Hargrove, R. H. THE GAS INDUSTRY IN 1946. *Am. Gas J.* **166**, 13-17 (1947) *January.*

The author reviews the advances in the gas industry during 1946, noting the increase in sales, the tremendous demand for gas heating, appliance production and developments, the expansion in the natural gas industry, research accomplishments and programs, the increase in industrial and commercial gas sales, and technical developments.

R. S. Goodrick

Gas Proration

Baumel, J. K. FEASIBILITY AND POSSIBILITY OF STATE-WIDE GAS PRORATION AND RATABLE TAKE. *Oil Weekly* **124**, 50-57 (1946) *December* 16; *Oil Gas J.* **45**, 54 (1946) *December* 14.

A discussion of the difficulties of imposing Statewide gas proration and the manner in

which they might be overcome. Mr. Baumel is chief engineer of the Texas Railroad Commission.

H. R. Batchelder

Gas Research

Dashiell, P. T. PRODUCTION RESEARCH COMMITTEE REPORTS TO MANUFACTURED GAS MEN. *Gas* 22, 50-52 (1946) *December.*

A summary is presented of the work accomplished and in process on the following: (1) Increase in capacity of water-gas sets, (2) Reforming of refinery or natural gas, (3) Research on mixed gases and interchangeability, (4) Study of the use of fluidization technique in gasification and (5) Production of high Btu oil gas.

H. R. Batchelder

LP-Gas Industry

Brennan, G. L. LP-GAS IN THE FIRST POST-WAR YEAR. *LP-Gas* 6, 18, 57-8 (1946) *December.*

The LP-gas industry has expanded rapidly during the past year. The volume increase in sales with end-use and product breakdown is shown by means of charts.

R. S. Goodrick

LP-Gas Industry

Coumbe, A. T. GAINS IN MOST LP-GAS USES SHOWN FOR '45. *LP-Gas* 7, 20-21 (1947) *January.*

Statistics are given for sales of LP-gas by use, by regions, and for the components of LP-gas, i.e., butane, propane, butane-propane mixtures, and pentane.

R. S. Goodrick

LP-Gas Industry

Oberfell, G. G. and Thomas, R. W. LIQUEFIED PETROLEUM GASES. *Natural Gases* 1947, 6-9 *January.*

The estimated marketed production of LP-gas during 1946 was 1,425,000,000 gallons, a 33.5 per cent increase over 1945 and three times that of 1941. The largest percentage increase in sales was to utility companies for gas manufacturing. There were also large increases in sales for household purposes and for the manufacture of chemicals. Data for the period 1922-1946 are presented in tables.

R. S. Goodrick

Natural Gas Prices

Williams, C. R. GAS DEVELOPMENT AND TRENDS IN SOUTH TEXAS. *Oil Gas J.* 45, 68-71 (1947) *January* 11.

Gas consumption has reached the value of over 4½ trillion cu. ft. per year. It brings 8 cents or less per Mcf in the West Texas fields and 25c Mcf in the eastern industrial area. Significant price factors are thought to be the economics of the Fischer-Tropsch process for making liquid fuels from natural gas and of the conversion of coal to "natural gas." The former process seems to be based on a natural gas value of from 8 to 12 cents per Mcf while the latter is based on a cost of 16 to 20 cents. The success of either process will greatly limit the well-head price of natural gas. The Federal Power Commission's action in limiting return to about 6½% of the total investment regardless of factors significant in exploration and development is viewed with some alarm.

J. D. Parent

New Pipe Line

Fisher, E. H. NEW 800 PSI WORKING PRESSURE GAS PIPE LINES CONNECT FIVE CALIFORNIA FIELDS. *Oil Gas J.* 45, 66-67 (1946) *December* 21.

The Pacific Public Service Co. is building a 35.9 mile pipe line to connect new wells with their existing line. The line includes sections of diameter varying from 4 inches to 12 inches and will provide 108,300 Mcf per day. The cost is $900,000 and the maximum design pressure is 800 psi.

J. D. Parent

AGA-BM Research Project

Burnham, C. H. N. A NEW RESEARCH PROJECT — PIPE LINE FLOW. *Gas* 22, 49 (1946) *December.*

Feeling the need of further work on the flow of natural gas through transmission lines the AGA has negotiated a second cooperative agreement with the Bureau of Mines. The program is as follows: (1) Review of literature and present usage; (2) Studies of fundamentals in the laboratory and on comparatively short sections of pipe lines; (3) Field studies on long pipe line systems; (4) Correlation of data, development of conclusions, and preparation of bulletin or monograph.

J. D. Parent

Synthetic Fuel Industry

Keith, P. C. SYNTHETIC FUELS PROMISE TO BOLSTER PETROLEUM RESERVES. *Chem. Eng.* 53, 101-103 (1946) *December.*

On the basis of German experience and American technological developments in converting coal to oil and to fuel gas, it is concluded that there is no impending oil shortage. Gasoline made from coal will compete in the near future with gasoline derived from crude oil. However, oil prices will probably increase when oil is produced from coal since the most optimistic estimate indicates a cost of $1.93 per barrel of synthetic oil produced at the coal mine from high quality coal purchased at $1.00 per ton. It is predicted that coal can be converted into high Btu gas (600-900 Btu) at low conversion costs ($1.00 per ton of coal) and piped to the market where it will compete with coal delivered in bulk. Finally, it is stated that there is impending competition between gas made from coal and natural gas. Costs of transporting coal, gas and oil for various distances are compared in four graphs.

C. H. Riesz

2. APPLIANCES

Corrosion of Water Heaters

Booth, N., Davidge, P. C., Fuidge, G. H. and Pleasance, B. CORROSION OF WATER HEATERS. EXPERIMENTS WITH INSTANTANEOUS WATER HEATERS. *Gas J.* 248, 1047-1053 (1946) *December* 11.

Experiments were conducted by the Gas Research Board (England) in cooperation with the South Metropolitan Gas Company to determine causes and methods of control of corrosion in domestic water heaters, particularly of the non-condensing type. Though other factors affecting corrosion were studied, the principal investigation concerned sulphur content of the gas. It was found that reducing the amount of sulphur from 17 to 3 gr. per 100 cu. ft. of gas reduced the amount of corrosion deposit, but only approximately proportionally. The weight of the sulphur in the corrosion deposit was found to be only 0.5 to 2.6% of the sulphur in the gas burned. The amount of sulphate in the deposit from any given heater remained quite constant though the amount of different metals varied considerably.

S. Dean

3. COMBUSTION AND INDUSTRIAL FURNACES

Aerated Burner Flames

Culshaw, G. W. and Garside, J. E. A STUDY OF AERATED BURNER FLAMES. *Gas World* 125, 674-677, 696 (1946) *November* 30.

An experimental study of flame velocities, cone areas, and radius of curvature of propane flames is reported. It was found that the velocity of flame propagation is constant for a given propane-air mixture and pressure. Plots are given showing flame area vs. rate of mixture feed at various pressures and feed compositions, ignition velocity vs. percent propane in air, reciprocal of dead space vs. composition and pressure, and reciprocal of radius of curvature

vs. composition and pressure. Polyhedral flames and experimental procedure are discussed. References are included.

C. Von Fredersdorff

Efficient Fuel Utilization

Thompson, A. J. SOME FACTORS WHICH INFLUENCE THE EFFICIENT UTILIZATION OF FUEL IN INDUSTRIAL FURNACES. *Gas Times* **49**, 124-126 (1946) *November* 9.

A comparison of stack losses for city gas and fuel oil at various percentages of excess air are given. The author discusses thermal efficiencies as related to stack losses, insulation, and recuperators. Calculations comparing heat available with and without recuperators are included.

C. Von Fredersdorff

Gas Turbine Locomotive

Stanbury, W. A., Jr. GAS-TURBINE LOCOMOTIVE: NEW MOTIVE POWER FOR BIG COAL CUSTOMER. *Coal Age* **51**, 82-87 (1946) *October.*

Efficiency, economy and flexibility of the coal-fired gas-turbine are stressed as an answer to diesel competition. It is stated that major laboratory problems have been solved and that rail tests are scheduled for the summer of 1948. Vital design features are diagramatically illustrated. The coal burning gas-turbine locomotive is expected to, (a) involve negligible lubricating cost; (b) produce up to 50% more power in winter than in summer; (c) have an availability comparable to that of the diesel; (d) no refueling for 1000 miles; (e) thermal efficiency of 22.0 to 23.5 per cent, compared to 4 to 8 per cent for the average steam locomotive now in use, and (f) locomotive weight of 17 to 25 lb. per shaft horsepower compared to about 50 lb. for the diesel. Numerous other details of this interesting development are also presented.

A. D. Singh

Heat Treating Atmospheres

Eeles, C. C. and Shriner, M. E. PREPARED ATMOSPHERES. *Steel* **119**, 110-113, 154-156 (1946) *December* 2.

A code system of all prepared furnace atmospheres is presented as an aid in selecting suitable atmospheres for metal processing. Tables describing the characteristics of prepared atmospheres, atmospheres suitable for heat treatment of different materials, and manufacturers of equipment are presented.

C. Von Fredersdorff

Oxygen Conditioned Flames

Slottman, G. V. and Kerry, F. G. USE OF OXYGEN IN THE OPEN HEARTH. *Steel* **119**, 106-108, 149-152 (1946) *December* 2.

Experience indicates that a substantial reduction in charge and melt-down period of the heating cycle of open-hearth furnaces can be effected by the use of oxygen conditioning of the fuel, to increase the rate and efficiency of heating the cold charge. Oxygen conditioned flames have the following advantages: (1) Greater heat release per volume of flue gas, (2) High velocity, high temperature flame, and (3) Adjustable flame length by variation in oxygen to air ratio. The applicability of oxygen conditioned flames depends, of course, on the economics of any installation. The author presents a discussion on refractory life, volume of waste gas, fuel consumption, and oxygen purity.

C. Von Fredersdorff

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4. CARBONIZATION AND GASIFICATION

Carbonizing Properties of Coal

Reynolds, D. A., Davis, J. D., Brewer, R. E., Ode, W. H., Wolfson, D. E., and Birge, G. W. CARBONIZATION PROPERTIES OF WESTERN COALS. *U. S. Bureau of Mines Tech. Paper* **692** (1946).

In an investigation of the properties of western coals, 106 coals from seven western states were subjected to carbonization or related tests. These coals ranged in rank from subbituminous C through high-volatile A bituminous, although a major portion were bituminous coals. Fifty-five samples were carbonized by the BM-AGA method; plasticity tests were made on 55, agglutinating tests on 88, and laboratory assays on 29 coals. The results are presented by means of tables, graphs, and photographs.

R. Sharpley

Carbonizing Properties of Coal

Reynolds, D. A., Davis, J. D., Ode, W. H., Wolfson, D. E. and Birge, G. W. CARBONIZING PROPERTIES OF VELVA LIGNITE FROM WARD COUNTY, N. DAK., AND MONARCH COAL FROM SHERIDAN COUNTY, WYO. *U. S. Bur. Mines Tech. Paper* 695 (1946).

This report summarizes the results of the carbonization of two noncoking coals, Velva lignite from Ward County, N. Dak., and Monarch coal from Sheridan County, Wyo. Both samples were carbonized in the 13-inch BM-AGA retort at 500°, 600°, 700°, and 800°C., and Monarch coal was also tested at 900° and 1000°C. Partly dried samples of the lignite containing 8.0 to 10.1 per cent moisture were carbonized at 500°, 600°, 700°, and 800°C. in the 13-inch retort and at 900°C. in the 18-inch retort. The results are presented by means of tables and graphs.

R. Sharpley

Devolatilization of Coal

Singh, A. D. PARTIAL DEVOLATILIZATION OF COAL BY THE FLUIDIZATION PROCESS. *Gas* 22, 44 (1946) *December.*

Application of the fluidization principle to partially devolatilizing bituminous coals is discussed. An experimental flow diagram is illustrated and experimental procedure described. The following summary of results is presented: (1) It has been shown that particle size growth during fluidized devolatilization of bituminous coals can be controlled so that the fluidization of a bed of char can be maintained in the retort, (2) The volatile matter removal corresponds to that indicated by the standard crucible method and can be controlled within narrow limits, (3) The bulk density of a char containing about 18% volatile matter is approximately 75% compared to the raw coal. By incorporating iron ore flue dust, char with a density comparable to that of raw coal can be produced. Char made at 734°F. has a bulk density nearly equal to that of the raw coal and on blending with raw coal has yielded a satisfactory coke, (4) The char product consists of hollow spheres, with its inside surface showing a high glaze under the microscope, (5) By-product coke has been successfully made from char and raw coal mixtures, (6) Char with a volatile content higher than Pocahontas coal may be blended with raw coal to produce satisfactory coke, and (7) Other possible uses for char are suggested in the manufacture of smokeless domestic fuel, as a direct fuel in cyclone type furnaces and in complete gasification of bituminous coals.

A. D. Singh

Gasification with Pressure

GASIFICATION OF COAL IN HYDROGEN UNDER PRESSURE. *Gas J.* 248, 984-986 (1946) *December* 4.

The report deals with some preliminary results obtained from an intermediate scale apparatus operated by the British Gas Research Board at Poole to examine the reactions between hydrogen and coal which resulted in a high yield of methane. Several objectives are being sought, the most important being the gasification of coal under pressure to produce town gas and coke. Semi-coke and weakly-coking coals were used and both gave more than 100 therms of methane per ton when treated at 50 atmospheres with hydrogen preheated to 600-700°C. When using semi-coke it was found that size grading was important, the smaller material, including fines, producing the higher yields. It was also found that carbon monoxide in the hydrogenating gas promoted the formation of methane. More than 200 therms of methane were obtained per ton of coal when the supply gas contained 18.5% CO. Other factors which greatly affected yields were the design of reaction

vessels and experimental procedures. Included in the report are graphs and charts which indicate the yields obtained under the various conditions employed in making the tests. Among the conditions being investigated are variation of hydrogen-carbon monoxide mixtures, the presence of steam in the reactors, the size and grading of the charge and the temperature at which hydrogen is supplied. Further investigations are in progress to develop a full-scale process of complete gasification.

L. H. McEwen

Lurgi Gasification

Hollings, H., Hopton, G. U., and Spivey, E. LURGI HIGH PRESSURE GASIFICATION. *Gas J.* 248, 889-890, 895-7, 899 (1946) *November* 20.

The essential facts described by the authors are taken from the Final Report of the British Intelligence Objective Subcommittee. A detailed review of several articles published by F. Danulat in German technical journals up to 1942 is included. The Lurgi plant at Bohlen of the Sachsische Werke A. G. in which generators of 8.2 ft. internal diameter were put into operation in 1940 was visited by the above named subcommittee in May 1945. A large low temperature carbonization plant of the Lurgi "Spulgas" design, owned by the Braunkohle Benzin A. G. and adjacent to the other plant, is described. The objective of this plant was to supply tar made by low temperature carbonization of brown coal briquettes for hydrogenation purposes. Approximately 5,700 million cu. ft. (measured at 32°F. and 29.9 in. mercury pressure) per year of a 472 Btu gas was supplied from this plant at a pressure of 19 atmospheres to the cities of Leipzig and Magdeburg. The gasification plant consisted of five older generators built in 1940 and five modern ones constructed in 1943, all housed in one building. The gasification, which was continuous at 20-25 atmospheres pressure, used as raw material briquette pieces not suitable for low temperature carbonization together with larger lumps of brown coal, both crushed to a size ranging from ⅛ to ⅜ inch. The oxygen was supplied by a Linde-Frankel plant, housed in a separate building, consisting of four units, two of 35,300 and two of 70,600 cu. ft. hourly capacity. The oxygen was of 95 per cent purity. From the results of 1943, the thermal efficiency, i.e., the ratio of Btu-s in gas plus tar plus benzol to Btu-s in the coal charged, was 78.0 per cent. The efficiency of gas production, i.e., the ratio of Btu-s in gas to Btu-s in coal minus tar minus benzol, was 72.2 per cent. A series of operating results are given for high pressure gasification using brown coal and hard coal (bituminous coal) and for carbonization using hard coal. The former yielded 456 and 429 Btu gases, respectively, and the latter gave a 450 Btu gas.

J. J. S. Sebastian

Oxygen for Gas Producers

Newman, L. L. OXYGEN PRODUCTION AND UTILIZATION IN GAS MAKING PROCESSES. (Abridgment) *Gas* 22, 43 (1946) *December.*

The advantages of the use of oxygen in gas producers are: production of gas of as high heating value as that of blue water gas, and a considerably increased ratio of steam to oxygen or higher production rates. When produced on a sufficiently large scale the probable cost of the oxygen will be 14-18 cents per Mcf, all charges included. Developments in the production of oxygen by low temperature separation from air promise a decrease in the cost of production so that oxygen may soon be used advantageously for gas manufacture for public utility distribution. A number of gas making processes have been developed for the utilization of oxygen, replacing the alternate blasting and steaming of the water gas generator with a continuous operation in which oxygen is substituted for air. The Winkler type generator, which uses a fixed-fluidized bed, is a high capacity unit but it requires a reactive fuel and yields a lean gas which is costly to scrub, unless compression is otherwise required. On CO_2—free basis the oxygen requirement is high. Means for carburetion must also be provided. —The powdered fuel type generators, which operate with the fuel in suspension, promise greater economy in fuel and oxygen consumption and a solution of the problem of carburetion by the injection of oil into a suitable zone in the generator.—Fixed fuel bed type gener-

ators, operating under superatmospheric pressures with mechanical grates, yield a richer gas without carburetion and have lower oxygen requirement and high fuel and steam consumption. For highly reactive, low cost non-caking fuels the pressure type generator appears to be an excellent solution.—Fixed fuel bed type processes, operating under normal pressure with mechanical grates or slagging, require non-caking coal. Mechanical agitation may make the use of caking coal in these possible. Coals with ash of low fusion point may be used in the slagging operation, otherwise fluxing material must be admixed. The slagging generators, however, require more oxygen than the mechanical generators because of heat losses in the slag, although the oxygen requirements of all fixed bed generators are likely to be lower than those of generators with fixed-fluidized beds or with beds in suspension.—The high investment cost of an oxygen plant makes the use of oxygen for gas production economical only as a base proposition. The cost of oxygen for base load operation is also less because larger quantities are required, which decreases the unit cost of the oxygen. (Paper presented at the A.G.A. Convention, Atlantic City, October 7-11, 1946).

J. J. S. Sebastian

Water Gas Sets

Kennedy, E. F. INCREASING WATER GAS SET CAPACITY. *Gas Age* **98**, 23-25, 58, 60 (1946) *December* 26; *Am. Gas J.* **165**, 15-18

Due to the rapidly growing demand for gas, the Malden & Melrose Gas Light Co. of Massachusetts was forced to increase the capacity of one of their 11.5 ft. water gas sets which formerly operated on a 3.5 minute cycle with 10 sec. blow-run and 10,000 cu. ft. per min. average generator air rate, producing from ¾ in. screened coke and 14° Bé. oil 3900 Mcf of gas in 20 hours of continuous operation. The available ample blower capacity could not be utilized due to the occurrence of blow holes (around the edges of the generator shell) and to fuel blown over from the 4 ft. 6 in. fire bed at increased rates of blasting.—After nine months of experimenting and making appropriate changes, all difficulties have been overcome and the capacity of the set was increased by 41 per cent to an average rating of 5500 Mcf per 20 hours continuous operation. The blow holes in the fuel bed were eliminated by building the brick lining in the ash pit so that the grate opening was reduced to 6 ft. diameter, the internal diameter of the generator being 9 ft. 4 in. The cycle length was reduced from 220 sec. to 188 sec. and the total blow-run and air purge was increased to 16 sec. The up and back stream rates were increased from 155 to 200 and from 235 to 260 lb. per min., respectively, and the average generator blast rate was increased to 15,600 cu. ft. per min. A heavier fuel oil of 12.3° Bé. was used at an input rate increased from 38 to 85 gal. per min. in the carburetor and from 35 to 40 gal. per min. in the generator. To vaporize and crack the oil at these higher input rates the temperature in the superheater had to be increased from 1490°F. to 1600°F. The depth of the fire bed was increased from 4 ft. 6 in. to 7 ft., which includes the ash and clinker zone. To take care of the higher temperature in the generator, caused by the increased blast rates (the air stream ratio was increased from 37.9 to 41.1), a solid carborundum inner lining extending 5 ft. 1 in. above the grate line was installed. The carburetor is checkerless and contains ignition arches, and oil admission is secured by four multi-nozzle sprays installed through the sides below the ignition arch. Scurfing air nozzles are arranged circumferentially at the base of the shell. All valves are automatically and hydraulically operated. Further increase in generating capacity beyond the average 5500 Mcf per day of 20 hours cannot be obtained because of the necessity of removing the ashes and clinkers accumulated in 20 hours of operation, unless a fuel of lower ash content is chosen (the coke used at present contains 10 per cent ash) and equipment is provided for continuous charging and clinker removal.

J. J. S. Sebastian

5. NATURAL GAS AND NATURAL GAS CONDENSATES

Cold Enrichment with LP-Gas

Penney, P. and Churchill, W. COLD ENRICHMENT WITH LP-GAS. *Gas Age* 98, 30-31, 54, 56 (1946) *November* 28.

A propane-air plant of 11 to 13 million cu. ft. daily capacity recently put in operation at the Boston Consolidated Gas Company is described. The experiences at this plant during the coal strike of April and May 1946, when a mixture of coke oven gas, carburetted water gas and propane vapor was sent out, is given in detail. However, the use of butane was preferred because of its 18 per cent greater storage capacity on a Btu basis. Propane was used for pressurizing the butane storage tanks so that compressors equipped with automatic pressure switches would be needed only in very cold weather. The proportioning of air and LP-gas was accomplished by three butterfly valves, a "calorimixer" automatically maintaining the Btu within the desired range of 530-1000. The Btu value and the production rate were varied by turning of dials. The LP-gas-air, coke oven gas and carburetted water gas were mixed before entering the holders and about 5-15 minutes were required to start or stop the operation of the plant. The plant was used to maintain a higher minimum specific gravity of the send-out gas during the period when carburetted water gas was not made; to cold enrich carburetted water gas with straight LP-gas; to increase plant production with LP-gas-air mixtures of 530 Btu (which is the standard heating value of the send-out gas); and to increase the Btu of the send-out gas for the purpose of compensating for its higher than normal specific gravity. The latter became necessary during the soft coal strike when the coke oven gas supply was limited and the production of (higher gravity) carburetted water gas had to be increased. Sufficient propane vapor was added to the production gas so that for each increase in specific gravity of 0.01 above 0.45 the heating value would be raised 4 Btu above the 528 Btu base value. This cold enrichment of the water gas-coke oven mixture resulted in a modification of the burner characteristics of the send-out gas. The slow burning propane eliminated the "noisy burner" and the "flash-back" complaints, but it did not solve all of the service division's customary problems. Nevertheless, without cold enrichment of the high specific gravity gas the service division would have been swamped with many more complaints.—The experience at the Boston plant also showed that for each increase in heating value of 5 Btu above 530 Btu the volume of the gas sent out dropped 1 per cent below that expected under similar conditions of weather and customer activity.

J. J. S. Sebastian

Corrosion in Wells

CORROSION AND PREVENTIVE METHODS IN THE KATY FIELD. *World Petroleum* 17, 64-67 (1946) *December.*

The article gives excerpts from a report to the API by R. C. Buchan of Humble Oil and Refining Co. on specific corrosion problems in the huge Katy gas field near Houston. Substantial progress in the control of subsurface and wellhead corrosion was reported but further research is still in prospect. The research program undertaken under sponsorship of the American Petroleum Institute, the Natural Gasoline Association of America and the National Association of Corrosion Engineers does not yet indicate any general measures which can be applied at all plants with equal success. Experience has shown that corrosion may be expected in condensate wells having pressures above about 1500 psi and reservoir temperatures above 160°F. if the gas contains CO_2 in excess of about 0.2 per cent by volume but each field must be studied separately since the conditions aggravating corrosion may vary not only with operating temperatures and pressures but also with production rates and the characteristics of the produced gas and water. The article also described briefly the Katy field, the plant process and operation.

J. J. First

Corrosion in Wells

Carlson, H. A. CORROSION IN HIGH- PRESSURE GAS-CONDENSATE WELLS. *Oil Gas J.* 45, 81-84 (1946) *December* 21.

Attention is called to the corrosion problem in high-pressure gas-condensate wells, and suggestions are made for research along this line. This includes measuring pH at well-head conditions and examination of surface films using the most modern techniques.

J. D. Parent

Distribution

Clutter, E. D. MORE NATURAL GAS FOR WESTERN PENNSYLVANIA. *Gas Age* 98, 11-12, 58 (1946) *December* 26.

The Manufacturers Light and Heat Co., Pittsburgh, has completed 54 miles of 20-in. high pressure line in western Pennsylvania. When placed in service it will initially bring more than 50 million cu.ft. of natural gas into its already extensive transmission and distribution network.

Author's abstract

Distribution

Person, K. W. PREPARATION OF DISTRIBUTION SYSTEM FOR INCREASED LOAD WITH NATURAL GAS. *Gas Age* 98, 19-20, 52-54 (1946) *December* 26.

The author summarizes means of increasing the capacity of a distribution system as follows: (1) increasing the differential between high and low points by the use of a loading device; (2) installing additional district regulators; (3) installing additional feeder and trunk lines; and (4) converting low pressure areas to high pressure areas. Each means is analyzed and discussed in some detail. The author feels that there is no unique answer to the problem and that each situation must be carefully considered separately.

J. D. Parent

Natural Gas Storage

Huff, W. J. MINIMIZING HAZARDS IN STORAGE OF LIQUEFIED NATURAL GAS. *Gas* 22, 45 (1946) *December.*

The author claims that the investigation relating to the fire of October 20, 1944 at the low temperature storage and regasification plant of the East Ohio Gas Co. showed that the unfortunate occurrence need not prevent future application of this attractive process if adequate precautions are observed in construction and operation. Reference is made to some work done at the Bureau of Mines on inflammability of natural gas-air mixtures. In particular, reference is made to Bureau of Mines Report of Investigations 3798 on the effect of pressure on inflammability limits for such mixtures. Some of these data are reproduced. Attention is also called to work done at the Bureau on ignition temperature which showed that this is not an absolute property, but one which depends on the balance between heat loss rate and rate of heat supply.

J. D. Parent

Peak Load Distribution

Novy, J. J. CHICAGO EXPERIENCES IN MIXING, SUBSTITUTING, SUPPLEMENTING GASES. (Abridgment) *Gas* 22, 42 (1946) *December.*

To satisfy the base demand of the city of Chicago during the summer months, the Peoples Gas Light & Coke Co. purchases and produces coke oven gas and mixes it with a 1040 Btu natural gas in 45/55 volume ratio, sending out an 800 Btu gas. As the demand in the late fall increases, part of the natural gas sold in the summer to several large industries through separate special mains on an interruptible supply basis, is diverted to sendout mixtures. The coke oven gas in part of the winter send-out is substituted by a 550 Btu reformed gas, made from a part of the diverted natural gas, and is enriched with the balance of the natural gas which has thus become available. Some 530 Btu carburetted water gas is also produced in the central station and enriched by natural gas, or a few of the sets may be used to produce an 840-850 Btu manufactured gas (of 0.63-0.64 gravity) containing 25-30% of blue gas and 60-65% of 1200-1250 Btu oil gas. This high Btu manufactured gas can be made in a conventional water gas set by the insertion of a high capacity oil spray in the generator and enlarging the wash-box drain. The straight substitution of the normal coke oven and natural gas sendout mixture for the 800 Btu car-

buretted water gas or reformed gas is avoided or reduced as much as possible, admixing only as much of these as is necessary with the normal send-out mixture. During very heavy demand in winter days, when a maximum sendout of 300 MMcf is expected as compared to an average day of 155 MMcf, mixtures of butane-air or propane-air might be used to supplement the normal sendout. Tests made indicated that it is possible to use up to 45% of an 1150-1200 Btu butane-air mixture, and up to 100% of an 1120-1270 Btu mixture of propane-air, in mixture with the normal coke oven and natural gas sendout, without serious effects on gas appliances.—The reforming of natural gas increased the 175 Mcf hourly capacity of carburetted water gas sets (11 ft. hand clinkered generators equipped with automatic valve control system) to 300 Mcf capacity per hour, replacing the 530 Btu carburetted water gas with a 550 Btu reformed natural gas. (Paper presented at the A.G.A. Convention, Atlantic City, October 7-11, 1946).

J. J. S. Sebastian

Pressure Maintenance

Patton, E. C., Jr. EVALUATION OF PRESSURE MAINTENANCE BY INTERNAL GAS INJECTION IN VOLUMETRICALLY CONTROLLED RESERVOIRS. *Petroleum Technology* 9, *Tech. Paper* 2098 (1946) *November.*

While admitting that it is next to impossible to accurately forecast future operations the author feels that a reasonably accurate prediction may be made as to the benefits of gas-injection for pressure maintenance. A very lengthy and detailed analysis is presented.

J. D. Parent

Reforming LP-Gas

Schneiter, R. E. REFORMING LIQUID PETROLEUM GASES IN WATER GAS MACHINES. *Gas Age* 98, 37-41, 84, 86 (1946) *December* 12.

An extensive study to determine the gain in set capacity obtainable by reforming liquid petroleum gases, for peak load production, in standard water gas machines was made at the Hunts Point plant of the Consolidated Edison Company of New York. It was stipulated that the oil input remain unchanged, superimposing the reforming on the normal operation without disturbing the heat equilibrium of the machine, so that it could be started and discontinued without undue changes in the operating procedure. Thus, the heat required for cracking the propane was obtained by a reduction in blue gas production, replacing the blue gas for 37 seconds of the usual 45 seconds total time of the back run with decomposition products of propane. Roughly, half of the propane decomposes by the reaction: $C_3H_8 = CH_4 + 2H_2 + 2C$, and the other half cracks as follows: $C_3H_8 = 4H_2 + 3C$. The 16.7 per cent increase in machine capacity calculated from the gas analyses made in trial runs closely checked the theoretically computed figure. However, in 24-hour plant tests using two water gas machines for propane reforming, 27 per cent increase in capacity above the normal 7500 Mcf per machine per day was obtained. In these plant tests the propane admission was automatic, extending over the full 45 seconds of the back run, and part of the propane probably went for cold enrichment. In one 24-hour run 9767 Mcf of 651 Btu gas of 0.781 specific gravity was obtained, and in a second 24-hour run the total production was 9331 Mcf of 604 Btu gas of 0.766 specific gravity. By reducing the heating value of the make gas to the required 540 Btu by the addition of 125 Btu producer gas, an effective daily machine capacity of 12,380 Mcf was obtained. This is an increase of 65 per cent over the normal 7500 Mcf daily capacity. This increment is sufficient to meet peak load requirements or it may be used as a standby for unforeseen breakdowns.—Operating results and notes on plant design and performance are given. The cracking of LP-gases liberates free carbon, which reduces the coke input, although not to the extent of the amount of carbon deposited. The propane reforming did not aggravate smoky conditions at the generator, attending heavy oil operation. In fact, the machines appeared to come off cleaner than usual.—Assuming a realizable increment of 20,000 Mcf per day and with storage capacity for three days, the investment cost is estimated to be $10.00 to $15.00 per Mcf of incremental capacity. The production cost per Mcf of gas resulting from reforming is somewhat higher

than that of the base load plant, although in view of the short duration of operation this additional production cost is secondary to the savings in investment.

J. J. S. Sebastian

Reservoir Calculations

Campbell, J. H. CORE ANALYSIS—PRACTICAL APPLICATION TO OIL AND GAS RESERVOIRS. *Petroleum Engr.* **18**, 100-104 (1946) *December.*

The use of porosity, permeability and other core properties for reservoir calculations is presented.

J. D. Parent

Unitization and Gas Injection

Barnes, K. B. WEST EDMOND'S UNITIZATION AND GAS INJECTION PROJECT WOULD BE ONE OF LARGEST. *Oil Gas J.* **45**, 70-71 (1946) *December* 14.

735 wells are now being operated by 32 different companies on 305 leases in the West Edmond pool which covers 29,400 acres. The pool is now about ⅜ depleted. Operators have combined to draw up plans for unitized operation so as to permit the most economical operation of the area. It is felt that this will increase the ultimate economical output from 140,000,000 bbls. to 150,000,000 bbls. and will conserve natural gas, much of which is now being vented to the air. Economies are also expected in the form of more favorable contracts and more gas sales. Unitization will permit gas injection which, if done independently, would result in movement of oil and gas across lease lines to the disadvantage of those injecting. It is expected that gas injection would permit the recovery of an additional quantity of oil amounting to 40,000,000 to 80,000,000 bbls. If the new plan is acceptable to the Oklahoma Corporation Commission and the operators, each operator and royalty owner will receive a fixed percentage of the revenue from the entire field in accordance with the value of his own tract as determined by such factors as the acreage, bottom hole pressure, thickness of pay section, gas to oil ratio and productivity.

J. D. Parent

6. PETROLEUM AND SYNTHETIC LIQUID FUELS

Catalytic Desulfurization

Berg, C., Bradley, W. E., Stirton, R. I., Fairfield, R. G., Leffert, C. B., and Ballard, J. H. CATALYTIC DESULFURIZATION OF HIGH-SULFUR STOCKS BY THE COBALT MOLYBDATE PROCESS. *Trans. Am. Inst. Chem. Engr.* **43**, 1-12 (1947) *January.*

The cobalt molybdate desulfurization process developed by Union Oil Company of California permits the desulfurization of refinery stocks normally considered of value only as fuel oil components. The process employs as its fundamental operation the conversion of organically combined sulfur to hydrogen sulfide by contact with cobalt molybdate catalysts in the presence of hydrogen. Pilot-plant studies have shown that this process is effective in handling stock containing 5.0 per cent and more of sulfur. Product sulfur contents range from less than 0.1 per cent for light distillates to 0.5 per cent for the very heaviest distillates including material in the lubricating oil range. The investigation has evaluated important variables, such as, effect of hydrogen sulfide in the hydrogen gas and effect of temperature, pressure, space velocity, and hydrogen rate. The bulk of the pilot-plant studies have been conducted with light and heavy distillates produced by coking of Santa Maria Valley crude. The desulfurization operations completed provide an answer to the important problems of refining crude containing in the neighborhood of 5.0 per cent or more of sulfur to produce marketable motor fuel.

Authors' Abstract

Polyform Process

Bland, W. F. POLYFORM PROCESS UTILIZES EXCESS GASES IN UPGRADING NAPHTHAS AND GASOLINES. *Petroleum Processing* **1**, 243-244 (1946) *December.*

Technical details of the Gulf Oil Corporation's Polyform Process are presented in three articles (see *Gas Abstracts* 3, No. 1, 7). Existing thermal reforming towers can be operated at

300 to 400 psig pressure. Otherwise, additional compression and refrigeration equipment or new fractionators are needed. For initial installation, polyforming is estimated to be 25 to 50% more expensive than a similar thermal reforming unit. Since polyforming converts excess gas to gasoline in addition to naphtha reforming, the two processes are not directly comparable. The royalty is on the order of $7.50 per barrel of daily throughput capacity on a paid up basis. Twelve plants are now operating, six of which are Gulf units.

C. H. Riesz

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7. ANALYTICAL METHODS AND TESTS

Aniline Point Determination

Brown, C. W. AUTOMATIC DETERMINATION OF ANILINE POINT OF PETROLEUM PRODUCTS. *Ind. Eng. Chem. Anal. Ed.* **18,** 739-741 (1946) *December.*

An apparatus is described for the automatic determination of aniline point of petroleum products. The basic principle involved comprises the use of an electric eye as a substitute for visual observation. The test sample is internally heated or cooled, the temperature is maintained uniform by stirring, and temperature equilibrium is automatically accomplished by a relay system. The relay system which controls the heating or cooling is activated by directing a light beam through the sample on a photocell, the light beam being interrupted periodically as the sample clears or clouds with slight temperature change. The flashing of a lamp bulb indicates when equilibrium temperature is reached.

Author's abstract

Assaying Oil Shale

Stanfield, K. E. and Frost, I. C. METHOD OF ASSAYING OIL SHALE BY A MODIFIED FISCHER RETORT. *U. S. Bur. Mines R. I.* 3977, 1-11 (1946) *October.*

Before initiating a survey of oil shales of the United States, the Bureau of Mines investigated new methods for assaying oil shales. Fischer cast aluminum retorts, similar to those used for low-temperature carbonization tests on coal, were adapted for checking 100-400 gram samples of oil shale. Preliminary experiments were made to demonstrate the effect of the following variables upon oil yield: (1) Charge weight, (2) Particle size, (3) Retorting time and temperature, and (4) Aluminum addition to charge. A retorting procedure, based on the results of the preliminary work, was developed and compared with the older Bureau of Mines method for assaying shale oil. The new method, referred to as the "Method of Assaying Oil Shale By a Modified Fischer Retort," has the following advantages over the older B.M. procedure: (1) Assay time is 65% lower, (2) Less sample is required, (3) Greater control of retorting operation is possible, (4) Results are more reproducible, and (5) Higher oil recovery is obtained.

H. Hakewill

Chromatography

Vahrman, B. CHROMATOGRAPHIC ADSORPTION ANALYSIS. *Brit. Coal Utilization Research Assoc. Monthly Bull.* **10,** 305-313 (1946) *October.*

A brief history and description of improvement in chromatographic technique is given. The various types of chromatography and examples of their uses are discussed. Topics included in the article are: (1) Standardization of adsorbents, (2) Construction, filling and extrusion of columns, (3) Chromatography, (4) Chromatography in reverse, (5) Partition chromatography, (6) Separation in vapor phase, (7) Zeolites and ion-exchange resins and (8) Two-dimensional chromatography. Some of the applications of chromatography to coal chemistry and related fields are pointed out. References on the separation of coal tar and its derivatives, coal bitumens, hydrogenation products of coal and tar, petroleum, and impurities in solvents are noted with outlines of a few of the pertinent details of each. A short statement on the theory of chromatography concludes the paper. 103 references.

H. Hakewill

Spectroscopy

Glasgow, A. R., Jr., Streiff, A. J., Willingham, C. B. and Rossini, F. D. ANALYSIS OF ALKYLATES AND HYDROCODIMERS. *Petroleum Refiner* **25**, 527-553 (1946) *November.*

The results of the work by the American Petroleum Institute on Research Project 6 at the National Bureau of Standards are given on the analyses with respect to individual hydrocarbon components of 28 different alkylates and hydrocodimers. The analyses were made utilizing analytical distillations performed at high efficiency with high reflux ratio, and with accurate measurements of boiling points (taken during the distillations) and refractive indices of the distillate fractions. The paper includes a summary of the subsequent spectrographic analyses, with respect to individual components, of one of the C_4 alkylates by six different laboratories involving one Raman, one mass, and four infrared spectrometers.

M. C. Miyaji

Spectroscopy

Rosenbaum, E. J., Martin, C. C. and Lauer, J. L. QUANTITATIVE ANALYSIS OF HYDROCARBON MIXTURES BY MEANS OF RAMAN SPECTRA. *Ind. Eng. Chem. Anal. Ed.* **18**, 731-3 (1946) *December.*

Monochromatic light from a mercury arc is passed into a small sample of the unknown liquid and the scattered light containing lines of modified wave length (Raman lines) is recorded upon a photographic plate. The intensities of characteristic lines are compared with the intensities observed with the pure compound under identical exposure and photographic processing conditions. The results are analyzed by means of an empirical averaging process based on the fact that intensity ratios are less affected by variations in exposure and development conditions than absolute intensities. The method is illustrated by analyses of 4— and 5—component aromatic mixtures and a mixture of trimethylpentanes.

C. H. Riesz

Sulfur Trioxide Determination

Axford, D. W. E. and Sugden, T. M. THE ESTIMATION OF SULPHUR TRIOXIDE IN ITS MIXTURES WITH SULPHUR DIOXIDE BY THE METHOD OF AMPEROMETRIC TITRATION. *J. Chem. Soc.* **1946**, 901-908 *(October).*

The method of amperometric titration has been used to determine the sulphur trioxide content of sulphur dioxide-sulphur trioxide mixtures in which the proportion of the latter is about 2% of the whole. The gases were absorbed in N-sodium hydroxide, followed by acidification and removal of sulphur dioxide by a current of nitrogen, with glycerol in the solution to inhibit oxidation of the sulphite. The sulphate solution was then neutralized and titrated amperometrically with lead nitrate solution using a simple type of polarograph.

Author's abstract

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8. GENERAL AND PHYSICAL CHEMISTRY

Vapor Pressure of Carbon Dioxide

Gordon, A. R. and MacWilliam, E. A. THE VAPOUR PRESSURE OF SOLUTIONS OF CARBON DIOXIDE IN DIFLUORODICHLOROMETHANE. *Can. J. Research* **24**, 292-296 (1946) *November.*

The vapour pressure of solutions of carbon dioxide in Freon has been determined at 10° and 20°C. for pressures up to 25 atm. At both temperatures, the vapour pressure is roughly linear in the mole fraction of carbon dioxide, the deviations being positive for solutions low in carbon dioxide and negative for solutions high in carbon dioxide; for a given concentration, the deviation becomes more negative the higher the temperature.

Author's abstract

9. ORGANIC CHEMISTRY

Oxygenated Chemicals

Walker, J. C. and Malakoff, H. L. BASIC OXYGENATED CHEMICALS FROM C_1, C_2, AND C_3 PARAFFINS AND OLEFINS. *Oil Gas J.* 45, 59-65 (1946) *December* 21.

At present oxygenated hydrocarbons are commercially produced from the lower hydrocarbons by (1) direct oxidation, (2) dehydrogenation followed by oxidation or hydration, (3) oxidation to carbon monoxide followed by hydrogenation of the carbon monoxide and (4) chlorination followed by hydrolysis. In the future the production of gasoline from natural gas by an adaptation of the Fischer-Tropsch process may produce large quantities of "by-product" oxygenated chemicals.

C. H. Riesz

Propane-Water System

Poettmann, F. H. and Dean, M. R. WATER CONTENT OF PROPANE. *Petroleum Refiner* 25, 635-638 (1946) *December.*

Three phase equilibria—aqueous liquid, propane-rich liquid and vapor were studied in the temperature range of 60° to 187°F. for the binary system water-propane. Equilibrium constant curves and weathering charts are presented for this system as well as for the water and n-butane system.

J. D. Parent

Thermodynamic Properties

Hanson, G. H. THERMODYNAMIC PROPERTIES OF SATURATED PROPYLENE, PROPANE, ISOBUTANE, ISOBUTYLENE AND NORMAL BUTANE. *Trans. Am. Inst. Chem. Engr.* 42, 959-973 (1946) *October-December.*

The thermodynamic properties of saturated propylene, propane, isobutane, isobutylene and normal butane have been correlated using the data of various previous publications. The lower temperature ranges of the tables are respectively, —100, —75, —20 and 0°F. and the upper limits are the critical temperatures. Data include vapor pressures, densities and specific volumes, latent heats of vaporization and enthalpies and entropies of saturated vapors and liquids. Data are given on the basis of one pound pressure and at 5°F. intervals.

S. Katz

Vapor Pressures

Hachmuth, K., Hanson, G. H. and Smith, M. L. VAPOR PRESSURES OF TWELVE FOUR-CARBON-ATOM HYDROCARBONS. *Trans. Am. Inst. Chem. Engr.* 42, 975-982 (1946) *October-December.*

A correlation has been made of the published data on the vapor pressures of twelve four-carbon-atom hydrocarbons from various lower temperatures between —100° and —20°F. up to the critical temperatures in 10°F. intervals. Pressures are given in lbs. per sq. in. The data are also presented on a large-scale vapor pressure chart.

S. Katz

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10. CHEMICAL ENGINEERING

Gas Deviation Determination

Armstrong, E. N. BURNETT APPARATUS USED FOR GAS-DEVIATION DETERMINATIONS. *Oil Gas J.* 45, 82-84, 114 (1946) *December* 7.

The metering of large volumes of gas mixtures at high pressure in transmission lines necessitates the periodic determination of the deviation from Boyle's law. Burnett *(J. Applied Mechanics, December* 1936) has described an apparatus in which measurements of pressure alone in a constant volume and constant temperature system are made. The present article gives a brief description of the design and operation of an installation, together with operating notes and results of a typical run.

S. Katz

Mean Temperature Differences in Field Tube

Hurd, N. L. MEAN TEMPERATURE DIFFERENCE IN THE FIELD OR BAYONET TUBE. *Ind. Eng. Chem.* 38, 1266-1271 (1946) *December.*

Derived equations and curves are given for the mean temperature difference across the outside tube wall for the four possible arrangements of longitudinal fluid flow in the Field or bayonet tube. A concept of equivalent greater and lesser temperature difference is introduced from which the true mean temperature difference may be obtained by taking the logarithmic mean through the usual chart or slide rule methods. This concept appears to have promise of general application to heat transfer problems involving varying surface arrangements for "mixed" streams in combinations of concurrent and counter-current flow.

Author's abstract

Measurement of Joule-Thomson Effects

Johnston, H. L. AN APPARATUS FOR MEASURING JOULE-THOMSON EFFECTS IN GASES BY DIRECT EXPANSION THROUGH A VALVE. *J. Am. Chem. Soc.* 68, 2362-2366 (1946) *November.*

Porous plugs have usually been used in measuring the Joule-Thomson effect. Valves offer advantages in simplicity of construction and operation, and their unpopularity is due to their tendency to permit "heat seals" between the two sides of the system. In the present paper, an apparatus is described in which non-metallic materials, including wood, glass and plastics have been used in the valve. Tests with hydrogen show that the effect is independent of flow rate over a wide temperature range, indicating that thermal conductivity is not significant. The apparatus has been used for the determination of the Joule-Thomson effect for hydrogen and deuterium and the data have been used to calculate the heat contents of these as functions of pressure and temperature.

S. Katz

Viscosity-Temperature Relationships

Beckmann, R. B., Corneil, H. G., and Michael, R. J. PILOT PIPE-LINE UNIT FOR DETERMINING VISCOSITY-TEMPERATURE RELATIONSHIPS. *Trans. Am. Inst. Chem. Engr.* 42, 947-958 (1946) *October-December.*

A pilot pipe-line unit and the experimental technique used in determining the apparent viscosities of high vapor pressure, waxy crude oil samples at various temperatures are described.

Authors' abstract

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11. PROCESS EQUIPMENT AND INSTRUMENTATION

Cottrell Precipitator

Patterson, K. J. THE COTTRELL ELECTROSTATIC PRECIPITATOR AS APPLIED TO THE CARBONIZATION INDUSTRY. *National Gas Bulletin of Australia* 10, 11-14 (1946) *September-October.*

In connection with the proposed construction and operation of a small pilot plant in which to study the carbonizing properties of various Australian coals a Cottrell electrostatic precipitator is intended for use for the removal of tar-fog from the gas. The present article is the result of a literature survey made preliminary to local construction of the precipitator. The article gives the historical background of the precipitator, describing the work of Hohlfield, Lodge, Walker and Cottrell, the latter being the first to successfully build a commercial electrostatic precipitator. The fundamental theory underlying the precipitator is presented, comparing the spark discharge between two electrodes, one charged and the other grounded, with the corona discharge which is obtained when the potential applied to the electrode is not great enough to cause a spark but merely ionizes the gas molecules around the charged electrode. In electrostatic precipitation the corona discharge is used. The dust particles

passing through this discharge become charged and move to the electrode of opposite charge where their charges are neutralized. The construction of the Cottrell precipitator for detarring practice is described as a set of parallel pipes arranged within a circular shell as the positive or collecting electrodes, negative electrodes being in the form of a stainless steel wire stretched concentrically in the pipe. Methods are given for generating high tension direct current which is imperative in all commercial precipitator practice. Voltage varies from 30 to 70 kv. according to the size of the unit and the highest efficiency of precipitation will be obtained at the highest possible voltage that can be applied without continual flashing over. The optimum rate of gas flow through the precipitator is about 5 linear feet per second for the standard tubes because, with a current of 5 milliamperes flowing through each unit, this gives a precipitation efficiency of 99 per cent for the average gas. The precipitator may be operated at temperatures in the neighborhood of 1200°F. although the usual temperature in gas works practice is 90 to 100°F. Protective cages are used on the high temperature generators and leads to prevent the unit from being approached while in operation as the voltage used is large enough to kill a man instantly.

J. J. First

Cyclone Efficiency

Parent, J. D. EFFICIENCY OF SMALL CYCLONES (AEROTEC) AS A FUNCTION OF LOADING TEMPERATURE AND PRESSURE DROP. *Trans. Am. Inst. Chem. Engrs.* 42, 989-999 (1946) *October-December.*

This represents a progress report presented before the Spring Meeting of the American Institute of Chemical Engineers on one phase of some work done for the Locomotive Development Committee of Bituminous Coal Research at the Institute of Gas Technology in Chicago, Illinois. The efficiencies of Aerotec cyclone-type dust cleaners of two inch and three inch diameters are reported as functions of temperature, dust loading and flow rate. Equipment and laboratory procedure details for testing efficiency are given.

J. D. Parent

Dehydration Plant

Reid, L. S. PERRYVILLE'S UNIQUE DEHYDRATION PLANT. SOUTHERN NATURAL GAS CO. INCORPORATES UNUSUAL FEATURES IN AUTOMATIC INSTALLATION. *Gas* 22, 34-37 (1946) *December.*

The fundamental design of the Perryville, La. dehydration plant (75,000 Mcf per day rated capacity at 450 psi) is quite conventional, for the gas is contacted by a countercurrent flow of 95% diethylene glycol solution to remove the desired quantity of water vapor. However, the process was made fully automatic and foolproof, capable of supervision by a field dispatcher as a part of his regular duties, providing efficient dehydration at all times regardless of load variations, by simplifying the process, providing automatic controls and alarms and eliminating several less important features usually found in more conventional installations to minimize the initial cost. The principal simplifications are: (1) installation of direct fired reboiler on the fractionator (cheaper, simpler and safer to operate than steam or Dow-therm boiler or oil heater); (2) constant rate of glycol circulation regardless of variations in gas throughput; (3) combination of fractionator feed pre-heater and reboiler, eliminating need for separate units; and (4) operation of the fractionator at atmospheric pressure, eliminating back pressure controls and effecting a saving in fuel.

J. J. First

Equipment Costs

Happel, J., Aries, R. S., and Borns, W. J. EQUIPMENT COSTS AND OTHER ITEMS IN ENGINEERING ECONOMICS. *Chem. Eng.* 53, 97-100 (1946) *December.*

This is the second half of the authors' article which concludes a discussion of investment costs begun in the October issue and considers operating costs and expenses, taxes, profits and economic evaluation methods. Ranges of cost are presented for the following investment costs: instruments, electrical equipment, generators (furnaces and steam), tanks and gas holders, concrete, structural steel, insulation, fireproof-

ing and painting, buildings and other construction expenses. Under operating costs and expenses are treated costs of labor, utilities and overheads. Short discussions follow on income tax and profits and economic evaluation.

J. J. First

Fractionating Column

Brandt, P. L., Perkins, R. B., Jr. and Halvorson, L. K. OPERATING CHARACTERISTICS OF HYPERCAL FRACTIONATING COLUMNS. *Oil Gas J.* 45, 86-90, 102 (1946) *December* 7.

The fractionating columns studied were vacuum jacketed Hypercal columns packed with 25 mm. by 36 in. Heligrid packing—among the best of the high efficiency column packings developed in recent years. One type of column was equipped with Podbielniak-designed integral reflux control heads and the other with control heads designed by technicians of Shell Oil Co., Inc. In each type the reflux ratio is controlled by means of a suitable timer switch actuating a solenoid which closes and opens the distillate line. The results of a series of tests demonstrate the excellence of the Heligrid packing. The equivalent of 90 theoretical plates and a hold-up of 0.36 ml. per theoretical plate were obtained at boil-up rates of 500 ml. per hour. The fractionating efficiency fell off with increasing boil-up rate. At 2000 ml. per hour the theoretical plate value was 48 and the hold-up 1.07 ml. per plate. In each case the best results were obtained by pre-flooding the column, followed by lowering of the heat input to the column and considerable time at total reflux in order to attain equilibrium.

J. J. First

Gas Lift Equipment

Davis, L. F. DESIGN, INSTALLATION, AND OPERATION OF GAS LIFT EQUIPMENT. *Petroleum Engr.* 18, 60-70 (1946) *December.*

For every type of well there is a type of gas lift equipment most suitable. Automatic differential controlled flow valves are suitable for rates greater than 40 bbl. an hr., and lifts of less than 2500 ft. Surface controlled intermitters are suitable for any depth and rates from 1 bbl. a day up to 400 bbl. a day in 2-in. tubing, and 1000 bbl. a day in 2½ in. tubing. Other types of valves are available for varying well conditions. Sketches are included that illustrate the various types of valves. For each type of equipment, formulae exist that facilitate the calculation of the proper setting depths for the various valves. Some variation is permissible from these formulae, based on local conditions. For successful installation of gas lift equipment there is required a clean well, field testing of equipment prior to installation, and the attention of an experienced man during the initial "kick-off" period. For successful operation of gas lift equipment constant and competent supervision is required to prevent gas wastage and high operating costs, especially where gas is purchased. Lift efficiencies vary widely, depending on the volumes handled, pressure available, feet of lift, type of equipment, etc. A table of lift data and efficiencies is given. Lowest efficiencies occur in West Texas stripper wells and highest efficiencies are in heavy volume water production with high fluid levels. Curves are given illustrating performance of gas lift equipment in various fields.

Author's abstract

Heat Exchanger

Collins, S. C. REVERSING EXCHANGERS PURIFY AIR FOR OXYGEN MANUFACTURE. *Chem. Eng.* 53, 106-107 (1946) *December.*

This paper describes a reversing countercurrent heat exchanger which eliminates water and carbon dioxide from air used for the manufacture of pure oxygen by low temperature condensation. Many similar schemes have been tried but in general the results have not been satisfactory, either because too much extra equipment is required, or the power loss is too great, or the impurities are not completely removed, so that an auxiliary chemical purification train must be provided. The reversing countercurrent heat exchanger here described does a complete job of purification and since the oxygen product flows uninterruptedly in its own channel there is no sacrifice of purity. The equipment consists of a central channel surrounded by two annuli. The warm end is always placed at a lower ele-

vation than the cold end so that condensed liquid impurities will tend to flow toward the warm end. Compressed air flows upward in the inner annulus and is cooled by transfer of heat to the waste nitrogen which flows downward in the outer annulus, and to the pure oxygen which flows downward in the central tube. As the temperature of the air falls, impurities condense on the walls of the channel, first liquid water, then frost and finally (near the cold end) solid carbon dioxide. At the end of a predetermined period (2 to 4 minutes) automatic shifting of the valves causes the nitrogen and compressed air to swap channels. Air now flows upward in the outer annulus while waste nitrogen flows downward along the inner annulus. Impurities deposited on the walls of the inner annulus during the first half-cycle evaporate into the stream of nitrogen. At the same time condensible impurities accumulate on the walls of the outer annulus. The oxygen stream in the central tube is not disturbed. In order to facilitate the condensation of impurities it was found desirable to increase the heat transfer area by means of fins metallically bonded to the walls of the annulus. The extended surface thus added has from two to four times the area of the primary surface, or 1.3 sq. ft. of active transfer surface per pound of total weight of exchanger—a ratio which is relatively high. As a result of the development, low pressure generators were produced by several manufacturers during the war. Depending upon the oxygen cycle and the size of the machine, the operating pressure of the compressed air varies from 80 to 175 psi abs. Oxygen of high purity is produced.

J. J. First

Instruments for the Gas Industry

Corfield, G. INSTRUMENTS THE GAS INDUSTRY WOULD LIKE TO HAVE. *Gas* 22, 25-28 (1946) *December.*

The purpose of this discussion is to stimulate the development of new instruments or to invite the application of war-developed instruments or instrumental principles to the needs of the gas industry. Sixteen such needs are outlined. The instruments which would satisfy them range from an instrument for the determination of true temperatures of gases in pipes to entirely new instruments as for example, an odor or smell meter.

J. J. First

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12. MATERIALS OF CONSTRUCTION

Corrosion Prevention

Bart, S. G. STEEL PIPE ELECTROPLATED INSIDE FOR CORROSION RESISTANCE. *Corrosion & Material Protection* 3, 8-10 (1946) *October-December.*

By the "Lectro-Clad Process," developed during the war, more than 500,000 feet of material were processed from March 1944 to August 1945. The process, for which several patents are pending, electrolytically deposits a predetermined thickness of nickel or other corrosion resistant metals on the inside surface of pipe, tubing, fittings, etc. The process, commercially practical in every respect according to the author, develops a smooth, ductile, pore-free deposit, fully adherent to the base metal in thickness of from 0.005 to 0.100 in. A new plating machine was developed for this process. A unique feature of the process is that, contrary to results obtained in ordinary plating, the indentations in the surface of the metal to be plated receive a heavier coating than the high spots, thus tending to even the surface and resulting in smoother deposits.

J. J. First

Corrosion Prevention

Brownie, F. A. SOME EXPERIENCES WITH THE PROTECTION OF BARE PIPE LINES USING ZINC. *Gas Age* 98, 19-21, 27 (1946) *November* 28.

In 1939 two associated companies in Alberta, Canada started cathodic protection of a number of miles of natural gas pipe lines, some bare and some coated, as an alternative to pipe replacement. The cost of replacing 12 inch pipe was found to be two and a half times the cost

of replacing anodes, based on prevailing labor and material costs in 1941. However, an evaluation of effectiveness is difficult because of the lack of a reliable test technique and variable soil conditions. Generally, the results obtained are considered to be satisfactory although they are known to be poor in some instances.

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Corrosion Prevention

Clay, J. A., Jr. USE OF FORMALDEHYDE TO INHIBIT CORROSION. *Petroleum Engr.* 18, 111-114 (1946) *November.*

The injection of formaldehyde into wells inhibits two types of corrosion of oil field equipment, that due to hydrogen sulfide saturated brines or acids at low temperatures. It is believed that formaldehyde reacts chemically with the sulfides in the well fluids and the product of the reaction forms an extremely thin film over the subsurface equipment. Two years of experimentation have shown that, although formaldehyde may not always be 100 per cent effective as an inhibitor, it is usually at least 80 per cent effective when properly used. Direction for applying formaldehyde to high and low pressure wells are given.

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Corrosion Prevention

Laudermilk, J. I. FIELD STUDIES AND DATA ON CORROSION PROBLEMS IN SOUTHEASTERN NEW MEXICO. *Oil Gas J.* 45, 105-110 (1946) *December* 7.

The article deals with field studies of corrosion and related difficulties occurring in the oil fields of southeastern New Mexico. Two types of corrosion are treated: chemical, including electro-chemical and electrolytic. The chemical appears to be the more important type in New Mexico. Methods of combating chemical and electro-chemical corrosion are discussed. The former include the use of zinc coating galvanized tanks, wood tanks, organic coating and plastic coating for stock tanks and down the well treatment with the following chemicals: formaldehyde, hexametaphosphate with tannin, sodium chromate or zinc chromate, and caustic soda and tannic acid. Electrolytic corrosion is combated by cathodic protection and installation of plastic coupling, insulated flanges or similar equipment near the well-head in order to interrupt electric currents that might be introduced from the surface. Other difficulties, such as deposition of calcium carbonate, salt and paraffin in the equipment and wells, and casing leaks are briefly described, followed by applicable remedies. An addendum to the article is a discussion of specific corrosion problems and remedial measures in 12 New Mexico pools.

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Gas Holder

Pfaff, G. C. VERTICAL SHEET CONSTRUCTION FEATURED IN NEW ST. PETERSBURG GAS HOLDER. *Gas Age* 98, 25 (1946) November 28.

The 2,000,000 cu. ft. all-welded gas holder built by the Bartlett Hayward Plant of Koppers Co., Inc. for the city of St. Petersburg, Fla., employs vertical panels of $\frac{3}{16}$ in. open hearth steel sheets as one of its interesting construction features. Other features of the four-lift all-welded panel water-seal holder include heavy welded steel construction of the cup and grip of each section. Continuous welding of all seams provides greater strength and leaves no pockets where corrosion may start. Taking into account its location in a hurricane zone the gas holder was designed to withstand wind velocity of 100 miles per hour. The steel plates have a tensile strength of 50,000 to 60,000 lb. per sq. in.

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13. NEW BOOKS

Filtration

Dickey, G. D. and Bryden, C. L. THEORY AND PRACTICE OF FILTRATION. *New York, Reinhold Publishing Corp.*, 1946.

The book is divided into two sections: first, history, theory and principles; and second, various types of filters and data pertaining thereto. This latter part constitutes the major portion of the book. The information presented pertains mostly to the separation of solids from liquids.

R. S. Goodrick

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